WATER QUALITY AND ITS CONTROL edited by M. Hino, A. A. Balkema, Rotterdam, 1994, No. of pages: ix + 262. Price: £72.00 (hb). ISBN 90-5410-123-7.

MIXING AND TRANSPORT IN THE ENVIRONMENT edited by K. Beven, P. Chatwin and J. Millbank, Wiley, Chichester, 1994. No. of pages: xvi + 458. Price: £75.00 (hb). ISBN 0-471-94142-5.

These two books make an interesting comparison if only because they illustrate two strongly contrasting views of environmental science and the way it should be used to address environmental problems. They begin by claiming very different scopes. Hino is a review text concerned with the control of water quality using principles developed in engineering hydraulics, and with a commitment to solving specific environmental problems primarily through the use of predictive models: if we can predict, then we can control. The Beven *et al.* volume, dedicated to the memory of Dr Cath Allen, is different, not simply because its coverage extends beyond specific water quality problems, but also because its goal is less ambitious. It is primarily a research text with a commitment to increasing our understanding of specific environmental processes.

The Hino text begins with a feeling of complacency; many environmental problems have been resolved as a result of a long commitment by scientists and engineers. However, a hint of concern is expressed; many environmental problems are reaching global proportions (examples provided include climate change, drought and acid rain). Unfortunately, the subsequent chapters neither support this complacency nor provide evidence that hydraulic engineering is reducing the concerns; the quality of the chapters is also variable. Some (e.g. Stefan's and Bernhardt's papers on eutrophication) provide useful, if dated, summaries that are broad in scope and well explained. The paper by Ikeda on controlling water quality in river systems is effective, illustrating the way it is possible to undertake more holistic, basin-scale treatment of water quality problems. Others suffer from being much too specific, not simply because they focus on particular issues (e.g. Wada's Chapter on sediment-laden flows and Novak's on aeration processes at hydraulic structures), but also because of the narrow view of the means of controlling particular water quality problems (e.g. sand-flash channels for reducing reservoir sedimentation). Explanation is not perfect (e.g. Miyanaga *et al.*'s paper on the prediction and control of thermal stratification, in which the non-specialist reader would be rapidly lost, and where critical intercomparison of the different numerical models available for the prediction of thermal stratification is sorely lacking) and even repetitive (e.g. Stefan's and Bernhardt's papers, and Hino and Matsuo's and Ikeda's papers cover essentially the same material). One gets a distinct feeling from the Hino volume that a geomorphological contribution is unnecessary. The chapter on control measures for sediment-laden flows concentrates upon curative measures for the effects of sediment-laden flows in the vicinity of dams. The geomorphologist might undertake a more holistic appraisal of the problem, recognizing the downstream consequences of flushing and perhaps endeavouring to understand controls on the upstream supply of sediment which might ultimately lead to preventive rather than simply curative measures.

The Beven *et al.* volume is worthy of the geomorphologist's eye, if only because it contains a large amount of previously unpublished research and material not normally available in the geomorphological literature. It is not a complete summary of all contemporary research relevant to mixing and transport processes in the environment, but the text does not set out to provide this. It effectively fulfils the role of a state-of-the-art research text addressing a very wide variety of scales (from turbulence structures in the River Severn through to tidal currents and energy fluxes in the Bristol Channel), and although it contains some material peripheral to the process geomorphologist, most should find something of interest. Mentioning all 22 papers is not feasible, but a few are noteworthy. Wallis's paper on the simulation of solute transport in open-channel flow contrasts markedly with some of the papers in the Hino volume in presenting a clear and analytical summary of water quality models from first principles, showing how assumptions made by different models critically condition their suitability for particular problems. The paper by Green *et al.* is a natural supporting paper through its emphasis on developing model structure in the light of particular field contexts and the need to assess whether or not the chosen model structure is valid as the system evolves through time, and as one moves downstream through the river system. The problem is portrayed as governed by uncertainty, and the need for probabilistic/statistical treatment is emphasized. Some of the papers contain useful methodological (e.g. Höttges *et al.* on the use of digital imagery to measure mixing processes, and Jones *et al.* on monitoring instantaneous turbidity fluctuations) and theoretical (e.g. Smith's dynamic systems treatment of turbulence in the River Severn, and Kelsey *et al.*'s particle tracking model of sediment transport) developments.

So, there remains the question: where does the Hino text fail where the Beven *et al.* text succeeds? The answer is deeply buried within the latter in a paper by Chatwin and Sullivan. In an introduction to the topic of modelling environmental pollution, the point is made that a particular problem cannot be addressed without fundamental *understanding* of the processes responsible for that problem. The consumers of research often expect too much of existing knowledge in being able to provide answers to specific problems. This theme is reflected throughout the Beven *et al.* volume, where the emphasis is clearly upon increasing our knowledge through basic, but sophisticated, research, supported by the inclusion of the key concept of uncertainty at various stages during the volume. It reminds us that we cannot predict until we can at least explain, and that explanation will be conditional upon understanding complex, nonlinear, time-bound systems, whose behaviour will vary according to specific environmental circumstances. Knight *et al.*, for example, question the traditional use

of the law-of-the-wall in estimating boundary shear stress, notably in the presence of significant secondary circulation cells, and show that calculations of the boundary shear stress at any point in a river channel is inexorably linked to a complete understanding of the three-dimensional effects produced by longitudinal vorticity. By implication, this depends upon local upstream and cross-stream channel geometry. The Hino volume often fails in its endeavour because it implicitly assumes that we have sufficient knowledge to predict the behaviour of such systems. This is not to argue that the Beven *et al.* text simply satisfies the esoteric desire of the research scientist for more knowledge. Rather, one gets the impression that some of both the methods and results contained in the volume could have utility in dealing with specific environmental problems (e.g. the paper by George and Allen illustrates the need to understand less-organized flows in momentum transfer processes in lakes, which has clear implications for the dynamics of oil slicks).

Following on from this, one gets a much greater feel in the Beven *et al.* text of the importance of site-specific field investigation, where local boundary conditions are critical in determining the nature of the governing processes, and where each problem must be understood with reference to its local context (e.g. Green *et al.*). Despite some of the Hino papers focusing on specific issues, the *environmental* specificity of many problems is lost in the Hino volume papers (e.g. Miyanaga *et al.*'s very general discussion of thermocline formation). Again, one finds oneself asking: why? It follows from the previous paragraph. There is an inbuilt trust in the papers in Hino of the generality and suitability of models for prediction and therefore control. Stefan for instance, argues that the ideal model of lake-water quality simulates lake processes and their interconnected and interdependent relationships. However, despite recognizing the need for models to be developed for particular and environmentally specific problems, the lack of an effective database for model verification is described as the key limitation. Throughout the Hino volume one is led to forget that a model is only as good as our knowledge and the understanding used in its formulation, and that models may need to be formulated with reference to specific problems.

In summary, Beven *et al.* is a different type of text to that which most geomorphologists will be used to reading, but one that is worthy of attention, both because of some of the interesting pieces of research that it contains and because it reminds us of the importance of linking scientific investigation in the environmental sciences to both physical theory and specific field problems. The Hino text, fundamentally different in nature, assumes much more than one would like, both in terms of the quality of the explanation it provides and the level that our understanding of water quality problems has achieved.

STUART LANE
University of Cambridge

FRIEND: FLOW REGIMES FROM INTERNATIONAL EXPERIMENTAL AND NETWORK DATA edited by P. Seuna, A. Gustard, N. W. Arnell and G. A. Cole, International Association of Hydrological Sciences Publication No. **221**, IAHS Press, Wallingford, 1994. No. of pages: x + 525. Price: $75.00. ISBN 0-947571-04-3.

So valuable has been the recent growth of international collaboration in hydrology that one is almost tempted to forgive the acronymic humour with which it is so often accompanied. Recognition of the need to develop an international dataset, to support research essential to the better understanding of hydrological variability and similarity in both space and time, led to the establishment for northern and western Europe of FREND (Flow Regimes from Experimental and Network Data). The database was built up during the period 1985–1988 as a basis for regional hydrological research among the 13 countries of the then study area, and was subsequently enlarged to become FRIEND (Flow Regimes from International Experimental and Network Data), incorporating 3500 flow records from 17 countries, including some in eastern Europe. In its present form, FRIEND is a research project of the UNESCO International Hydrological Programme (IHP-IV). FRIEND research programmes have also been established in other areas, including AHMY (the Alpine and Mediterranean Hydrology region), and Southern and West Africa.

The proceedings of the first international FRIEND symposium, held at Bolkesjø, Norway, were published in 1989 under the acronymically incorrect title *FRIENDS in Hydrology* (Roald *et al.* 1989). Subsequent European FRIEND results have been reported in a three-volume report (Gustard, 1993) and in conference proceedings. This publication reports the results of the second FRIEND conference held at Braunschweig in October 1993, which provided a forum for the presentation and discussion of new research results and for the definition of future needs for regional cooperation in international research programmes.

After an introductory paper in which Gustard reviews the FRIEND research programme, the publication contains 60 papers arranged according to the six scientific themes of the conference: hydrological data bases (four papers); parameterization, catchment and regional modelling of low flow (16 papers); characterization of large scale variations in river flow behaviour with reference to hydrological macro-regionalisation (ten papers); techniques for extreme rainfall and runoff estimation (ten papers); catchment processes of streamflow generation